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Acceleration and Gravitational Acceleration Experiments in the Phyphox Virtual Laboratory

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ABSTRACT

This study aims to prove the relationship between 2 variables, namely the dependent variable (absolute acceleration) and the independent variable (height) in the acceleration experiment with the acceleration of gravity using the phypox virtual laboratory. The research method used is a combination method consisting of quantitative research methods and . The combination method can provide strong empirical data in proving 2 variables by using a virtual laboratory phypox as a medium in learning the concept of acceleration with gravitational acceleration. The results of this study show the potential for using a virtual laboratory phypox in proving 2 variables which results in a relationship between the value of altitude and absolute acceleration that is directly proportional.

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1. INTRODUCTION

Acceleration is a measure of speed that changes per unit time with the units being meters/second2 (m/sec2). The unit "g" is known as a unit of acceleration which is equal to the level of earth's gravity above the height of the earth's surface. This "g" unit has a value of 9.81 m/sec2. Some accelerations are static and some are dynamic. Static acceleration has a constant/stable force by continuously providing a pulling force to the legs. When the acceleration measuring instrument (accelerometer) is moved, you will see how an object is moved.

Acceleration has been widely studied by previous researchers. A real-time quantitative acceleration monitoring method based on triboelectric nanogenerator for bridge cable vibration was researched by Huang [1]. A wide pH compatible MoSx co-catalyst layer on a TiO2 nanowire array photoanode for simultaneous acceleration of charge carrier separation and catalytic reaction was investigated by Li [2]. Weak Anharmonicity Rationalizes Temperature-Driven Acceleration of Nonradiative Dynamics in Cu 2 ZnSnS 4 Photoabsorber was investigated by Zhang [3].

The acceleration strategy of the source iteration method for the stationary Boltzmann phonon transport equation was researched by C. Zhang [4]. The composite Anderson acceleration method with two window sizes and optimized damping was researched by Chen [5]. Multifunctional Photoactive Hydrogel for Accelerating Wound Healing was researched by Maleki [6].

A swarm of helical photocatalysts with controlled catalytic inhibition and acceleration by magneto-optical stimulation was investigated by Wang [7]. A review of the circuit and cellular level mechanisms that contribute to locomotor acceleration in the marine mollusk Clione Limacina was studied by Pirtle [8]. Multifunctional Photoactive Hydrogel for Accelerating Wound Healing was researched by Maleki [6].

A deep neural network-assisted metamodel for detecting skeletal damage using incomplete acceleration time series was researched by Lieu [9]. Different signaling signatures driving compensatory proliferation via S phase acceleration were investigated by Crucianelli [10]. The effect of cervical collars on head and neck acceleration profiles during emergency spinal immobilization and release procedures in elite soccer players: protocol for a randomized, controlled cross-over trial investigated by Callaghan [11].

Tracking Vold–Kalman filter sequences of axle box accelerations for track stiffness assessment was researched by Hoelzl [12]. Antimicrobial Prescribing in Telehealth Situations: A Stewardship Framework During a Period of Rapid Acceleration in Primary Care was researched by Sine [13]. The radiation pressure acceleration of protons from thin structured paper targets was investigated by Meinhold [14]. The plasma length scale and quantum electrodynamic effects on particle acceleration in extreme laser plasmas were investigated by Culfa [15].

Modeling cosmic acceleration with generalized varying deceleration parameters was researched by Koussour [16]. Acceleration of Chemical Reactions Due to Nonequilibrium Collision Dynamics: Polyaromatic Dimerization was studied by Morozov [17]. Breaking waves cause pressure and acceleration on large rocks at the top of cliffs studied by Steer [18].

Acceleration of wound healing with PVA-PEG-MgO nanocomposite hydrogel with human epidermal growth factor was studied by Bhattacharya [19]. An Acceleration-Guided Acoustic Signal Denoising Framework Based on Learnable Wavelet Transform Applied to Slab Track Condition Monitoring was researched by Dai [20]. Acceleration of Dynamic Ice Loss in Antarctica From Satellite Gravimetry was studied by Diener [21].

The influence of vehicle external acceleration signal lights on pedestrian-vehicle interactions was investigated by Li [22]. The effect of fracture models on structural damage and acceleration on naval vessels due to underwater explosions was investigated by Kim [23]. The causal theory of accelerated seed germination around high voltage direct current transmission lines was researched by Kumar [24].

A novel aging acceleration rate equation for accelerated weather aging test of high viscosity modified asphalt: Theoretical derivation and experimental correction was researched by Hu [25]. Experimental and theoretical studies of spherical flames of 2-ethylfuran: Cellularization, intrinsic instability and self-acceleration were researched by Bao [26]. Acceleration theory, temporal regimes, and current politics. The interview with Hartmut Rosa was researched by Torres [27].

DEM–SPH Coupling Method for Landslides Based on GPU Parallel Acceleration Technique was researched by Y. Zhang [28]. Acceleration of Singlet Oxygen Evolution by Superoxide Dismutase Mimetics in Lithium-Oxygen Batteries was investigated by Kim [29]. Thermokarst acceleration in Arctic tundra driven by climate change and fire disturbance was studied by Chen [30]

There is a new trend for the use of sensors, the use of communication tools and for carrying out processing, namely wearable devices. A wearable device or also known as a wearable system is a set of electronic devices with a minimal size that makes it easier to use without disturbing the user's activities. Sensors on wearable devices are useful for finding sensing in the wearable device's environment and the data they process can be processed directly through communication devices. Wearable systems have been widely used by various groups, including education, health, agriculture, sports, fashion, transformation and others.

The definition of a wearable device or wearable system is a set of electronics and computers used for clothing to be worn. So that the working system of this wearable system runs well, don't ignore the important role of sensors. The measuring instrument used to measure acceleration is called an accelerometer, this tool is used to measure the force produced during acceleration, especially measuring the gravitational speed, namely 1g. Gravity can be measured by acceleration to obtain a calculation of the angle of inclination of the device to a flat surface.

The acceleration measuring tool, namely the acceleromater, can be utilized using a smartphone. Because smartphones automatically have sensor features called accelerometer and gyroscope. By utilizing current technological advances, all work becomes easier.

The creation of sophisticated technology like today, provides comfortable and easy access to solve all problems and help people who are in trouble. Accelerometers are also found on smartphones, apart from that, gyproscopes, light and pressure sensors. An accelerometer is a sensor used to take measurements of acceleration, incline, tilt angle, impact, rotation, vibration and gravity.

According to gravity, the acceleration measure is (g=9.81 m.s2), to determine the location of the earth's surface by using the Global Position System or what is often known as GPS which is found on various mobile devices. In general, GPS has the function of tracking the location of a device using GPS Tracking or GPS Tracker.

2. METHODS

Figure 1. Flowchart of practicum implementation

The research method used is a combination research method consisting of qualitative research methods and literature study methods. The quantitative method is carried out using the acceleration (with g) research selector stage in the Phyhox application with the aim of obtaining data from acceleration (with g) experiments. Meanwhile, the literature method is carried out by searching a collection of books and journal articles related to acceleration (with g) experiments.

The system scheme in Figure 1 is that the experiment was carried out by collecting data using Phyhox which was developed by Prof. Heidrun Heinke, Dr. Sebastian Staacks Together with Prof. Christoph Stampfer. The data collection step was carried out using acceleration (with g) in the Phyhox application, which used sensors from an Android device using different quantities, carrying out experiments 16 times.

After carrying out the experimental procedure scheme, conclusions are drawn from the acceleration (with g) experiment by drawing conclusions from the experimental data that has been carried out and by matching and searching collections, books, journals and articles related to acceleration (with g).

3. RESULTS AND DISCUSSION

Table 1. Experiment with a height of 5 cm

Test	Height (cm)	Acceleration (m/s^2)			Absolute Acceleration (m/s^2)	Gravitational Acceleration (m/s^2)
		X	Y	Z		
1	5	-0,64	0,92	9,71	9,78	10
2	5	-1,03	-0,15	9,81	9,87	10
3	5	-0,16	0,59	9,77	9,79	10
4	5	0,07	0,13	9,86	9,86	10

Table 1. Experiment with a height of 5 cm. This is data generated with 4 trials and a height variable of 5 cm.

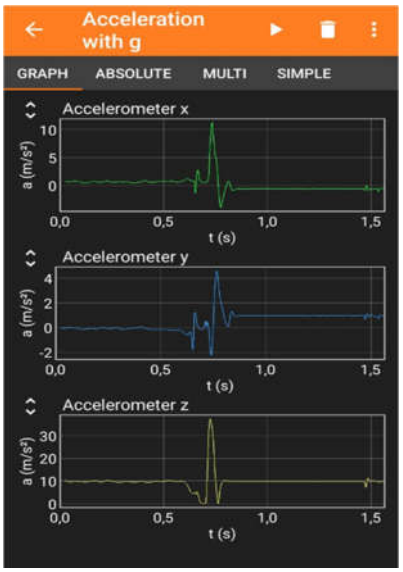

Figure 2. Experiment with a height of 5 cm using the Phyphox application

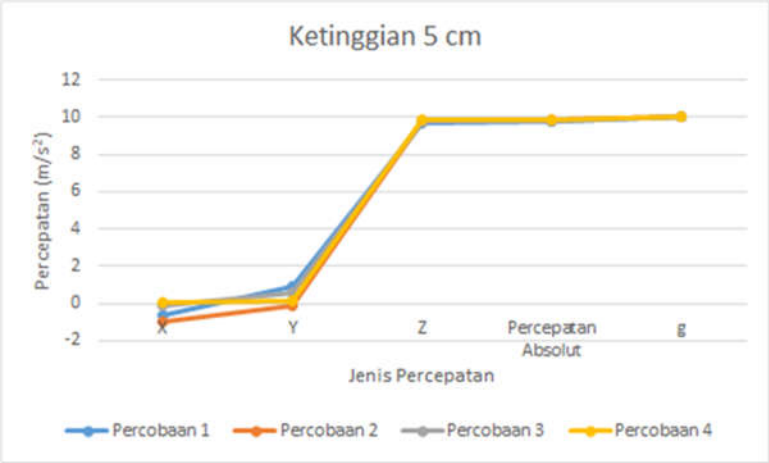

Figure 3. Experimental graph with a height of 5 cm

Based on the graphic results in Figure 2 above with a height of 5 cm with 4 experiments, it can be seen that the results of absolute acceleration are relatively unstable because the results of absolute acceleration depend on the researcher's accuracy.

Table 2. Experiment with a height of 8 cm

Test	Height (cm)	Acceleration (m/s²)			Absolute Acceleration (m/s²)	Gravitational Acceleration (m/s²)
		X	Y	Z		
1	8	-0,12	-0,22	9,55	9,56	10
2	8	0,06	0,12	10,44	10,44	10
3	8	-0,16	-0,00	9,58	9,58	10
4	8	-0,28	-0,15	9,55	9,56	10

Table 2. Experiment with a height of 8 cm. This is data generated with 4 trials and a height variable of 8 cm.

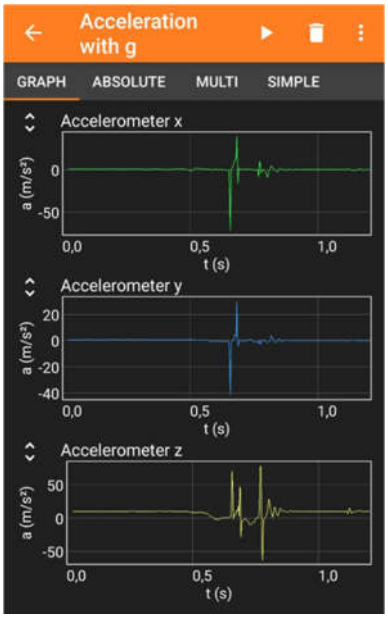

Figure 4. Experiment with a height of 8 cm using the Phyphox application

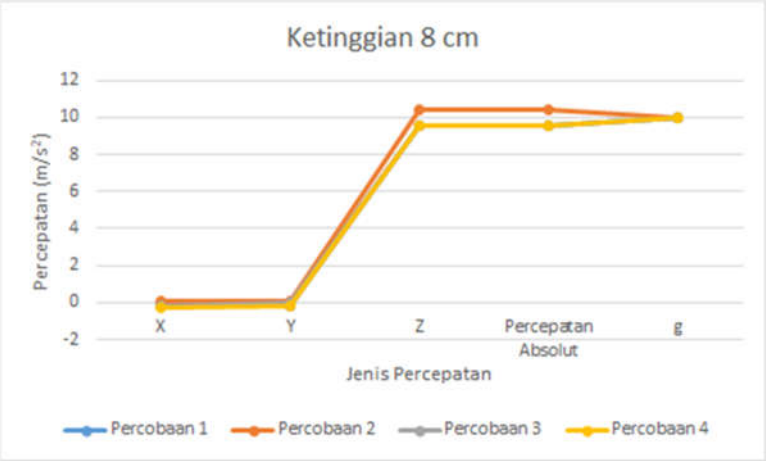

Figure 5. Experimental graph with a height of 8 cm

Based on the graphic results in Figure 4 above with a height of 8 cm with 4 experiments, it can be seen that the results of absolute acceleration are relatively unstable because the results of absolute acceleration depend on the researcher's accuracy.

Table 3. Experiment with a height of 11 cm

Test	Height (cm)	Acceleration (m/s^2)			Absolute Acceleration (m/s^2)	Gravitational Acceleration (m/s^2)
		X	Y	Z		
1	11	-0,18	0,13	9,42	9,42	10
2	11	-0,14	-0,02	9,77	9,77	10
3	11	0,18	0,03	10,31	10,89	10
4	11	-0,17	0,08	9,43	9,43	10

Table 3 Experiment with a height of 11 cm. This is data produced with 4 trials and a height variable of 11 cm.

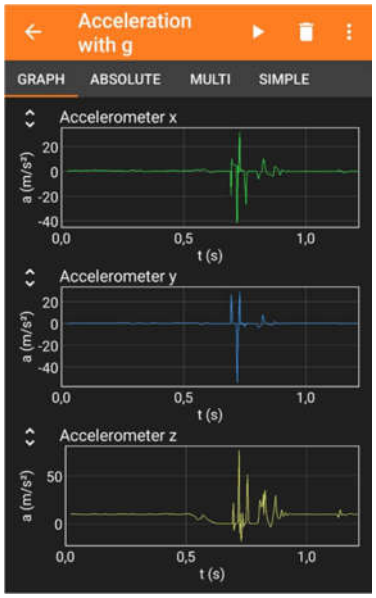

Figure 6. Experiment with a height of 11 cm using the Phyphox application

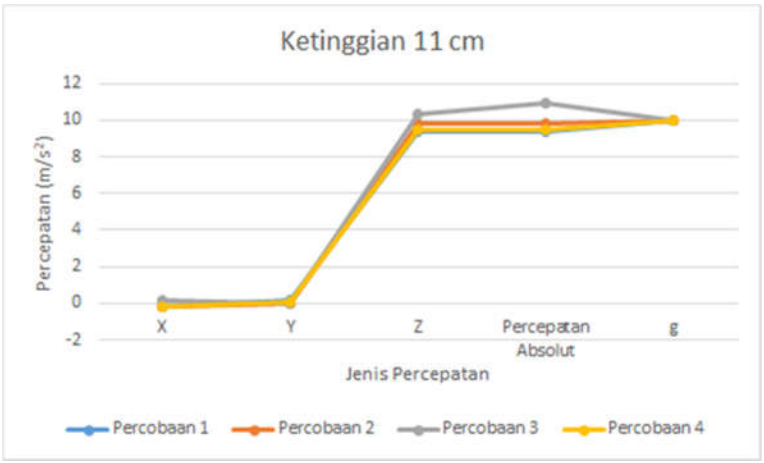

Figure 7. Experimental graph with a height of 11 cm

Based on the graphic results in Figure 6 above with a height of 11 cm with 4 experiments, it can be seen that the results of absolute acceleration are relatively unstable because the results of absolute acceleration depend on the researcher's accuracy.

Table 4. Experiment with a height of 14 cm

Test	Height (cm)	Acceleration (m/s²)			Absolute Acceleration (m/s²)	Gravitational Acceleration (m/s²)
		X	Y	Z		
1	14	-0,22	-0,09	9,69	9,70	10
2	14	0,18	-0,10	9,55	9,55	10
3	14	-0,83	-0,19	9,81	9,85	10
4	14	1,20	0,40	11,42	11,49	10

Table 4 Experiment with a height of 14 cm. This is data produced with 4 experiments and a height variable of 14 cm.

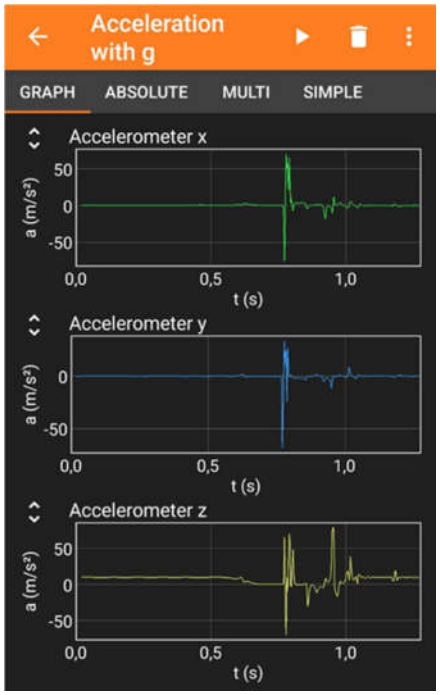

Figure 8. Experiment with a height of 14 cm using the Phyphox application

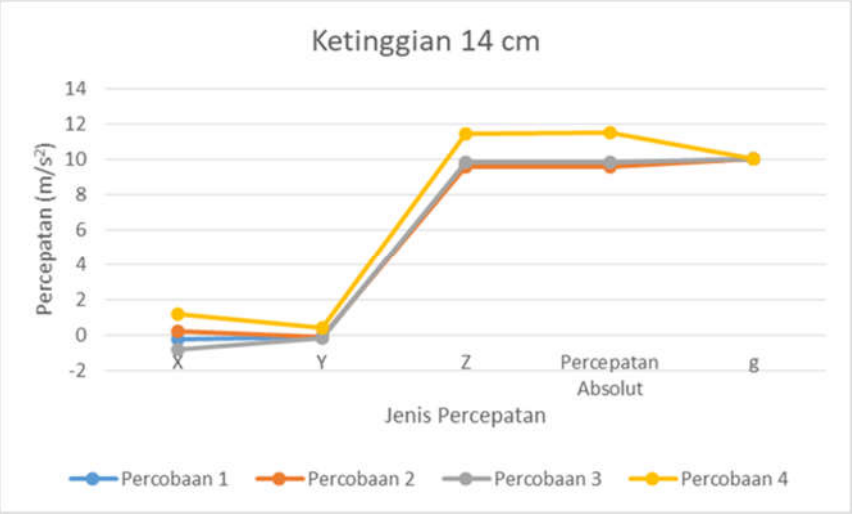

Figure 9. Experimental graph with a height of 14 cm

Based on the graphic results in Figure 8 above with a height of 14 cm with 4 experiments, it can be seen that the results of absolute acceleration are relatively unstable because the results of absolute acceleration depend on the researcher's accuracy.

The conclusion from the 4 graphs is that the value of height influences the results of the absolute acceleration value, where in each graph it can be seen that the greater the height value given, the absolute acceleration value will also be greater, conversely, the smaller the height value given, the absolute acceleration value will be the smaller it is, in other words the relationship between height and absolute acceleration is directly proportional.

Table 5. Effect of height on acceleration

Test	Height (cm)	Acceleration (m/s²)			Absolute Acceleration (m/s²)	Gravitational Acceleration (m/s²)
		X	Y	Z		
1	5	-0,64	0,92	9,71	9,78	10
2	5	-1,03	-0,15	9,81	9,87	10
3	5	-0,16	0,59	9,77	9,79	10
4	5	0,07	0,13	9,86	9,86	10
5	8	-0,12	-0,22	9,55	9,56	10
6	8	0,06	0,12	10,44	10,44	10
7	8	-0,16	-0,00	9,58	9,58	10
8	8	-0,28	-0,15	9,55	9,56	10
9	11	-0,18	0,13	9,42	9,42	10
10	11	-0,14	-0,02	9,77	9,77	10
11	11	0,18	0,03	10,31	10,89	10
12	11	-0,17	0,08	9,43	9,43	10
13	14	-0,22	-0,09	9,69	9,70	10
14	14	0,18	-0,10	9,55	9,55	10
15	14	-0,83	-0,19	9,81	9,85	10
16	14	1,20	0,40	11,42	11,49	10

In table 5 it can be observed that the relationship between height and acceleration can be seen when the height value increases gradually, the value of the acceleration experienced becomes greater. It can be concluded that the relationship between height and acceleration is directly proportional or can be interpreted as the greater the height value, the resulting acceleration value will be greater, and vice versa, if the height value is smaller, the resulting acceleration value will also be smaller.

4. CONCLUSION

The conclusion of this research states that there is a relationship between the two variables in acceleration and the earth's gravitational acceleration, namely the height variable determined by the researcher which is the independent variable and the absolute acceleration variable which is the dependent variable and the earth's gravitational acceleration as a constant value. The relationship between absolute acceleration and height produces a straight proportional relationship, or in other words, the greater the given height value, the greater the absolute acceleration value will be, conversely, the smaller the given height value, the smaller the absolute acceleration value will be.

DECLARATION

Author Contribution

This research is divided into three stages, namely the first stage of design and construction of the refractometer, the second stage of measuring the refractive index of cooking oil, and the third stage of analysis of the measurement results.

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Conflict of Interest

Declare conflicts of interest or state “The authors declare no conflict of interest.”

REFERENCES

[1] Y.-C. Lin, “Dual Window Phenomenon for Surface Plasmon Resonance Sensor Based on Plastic Optical Fiber,” Sensors Mater., vol. 32, no. 12, p. 4179, Dec. 2020.
[2] L. Hajshahvaladi, H. Kaatuzian, and M. Danaie, “Design of a hybrid photonic-plasmonic crystal refractive index sensor for highly sensitive and high-resolution sensing applications,” Phys. Lett. A, vol. 420, p. 127754, Dec. 2021.
[3] B. B. Choi, B. Kim, J. Bice, C. Taylor, and P. Jiang, “Inverse DVD-R grating structured SPR sensor platform with high sensitivity and figure of merit,” J. Ind. Eng. Chem., vol. 116, pp. 321–330, Dec. 2022.
[4] L. Fazzi and R. M. Groves, “Demodulation of a tilted fibre Bragg grating transmission signal using α-shape modified Delaunay triangulation,” Measurement, vol. 166, p. 108197, Dec. 2020.
[5] C. Liu, Y. Bai, J. Zhou, J. Chen, and L. Qiao, “Refractive index sensing by asymmetric dielectric gratings with both bound states in the continuum and guided mode resonances,” Opt. Express, vol. 29, no. 26, p. 42978, Dec. 2021.
[6] J. Surve, S. K. Patel, and J. Parmar, “Design of Cost-Efficient Graphene Metasurface-Based Pregnancy Test With NOR Gate Realization and Parametric Optimization,” IEEE Sens. J., vol. 22, no. 24, pp. 23937–23944, Dec. 2022.
[7] Y. Hong et al., “Solvent-Free Nanofabrication Based on Ice-Assisted Electron-Beam Lithography,” Nano Lett., vol. 20, no. 12, pp. 8841–8846, Dec. 2020.
[8] Z. Bao, J. Wang, Z.-D. Hu, Y. Chen, C. Zhang, and F. Zhang, “Coordination multi-band absorbers with patterned irrelevant graphene patches based on multi-layer film structures,” J. Phys. D. Appl. Phys., vol. 54, no. 50, p. 505306, Dec. 2021.
[9] M. H. Maghsoudian and H. Karimi-Alavijeh, “A Very Fast Single-Step Process for Optical Microfiber Long Period Gratings Fabrication,” J. Light. Technol., vol. 40, no. 24, pp. 7930–7936, Dec. 2022.
[10] H. Xu, H. Pan, M. Yang, Q. Du, Y. Lu, and Y. Chen, “Strongly Directional Fano Resonance in an Individual Silicon Nanorod,” J. Phys. Chem. C, vol. 124, no. 48, pp. 26486–26492, Dec. 2020.
[11] R. Janeiro, R. Flores, and J. Viegas, “Refractive index of phosphate-buffered saline in the telecom infrared C + L bands,” OSA Contin., vol. 4, no. 12, p. 3039, Dec. 2021.
[12] H. Fan et al., “Polarization-independent tetramer metasurface with multi-Fano resonances based on symmetry-protected bound states in the continuum,” Opt. Commun., vol. 525, p. 128864, Dec. 2022.
[13] S. Ahmed, M. Hamid, and M. Rahman, “Assessment of ghee adulterated with oils and fats in Bangladesh,” J. Adv. Vet. Anim. Res., vol. 7, no. 4, p. 678, 2020.
[14] K. Maeda et al., “High-Pressure crystallization of binary unsaturated fatty acids in cylindrical cell,” J. Cryst. Growth, vol. 576, p. 126380, Dec. 2021.
[15] H. Chen, T. Pan, and Z. Zhang, “Electromagnetic multipolar quasi-bound states in the continuum for optical sensing,” Opt. Commun., vol. 525, p. 128862, Dec. 2022.
[16] E. I. Golant, A. B. Pashkovskii, and K. M. Golant, “Lossy Mode Resonance Sensors Based on Double ITO/TiO2 and Triple TiO2/ITO/TiO2 Thin Film Coated Single Mode Fiber Taper,” J. Commun. Technol. Electron., vol. 65, no. 12, pp. 1457–1459, Dec. 2020.

[17] D. Rong, G. Meng, X. Fang, L. You, and Z. Deng, "Delafossite AgAlO 2 modified long-period grating for highly-sensitive ammonia sensor," Opt. Express, vol. 29, no. 25, p. 42005, Dec. 2021.
[18] N. Mohd Razali et al., "No-core fiber by self-image length optimization for optical based refractive index sensor," Opt. Fiber Technol., vol. 74, p. 103133, Dec. 2022.
[19] V. Semwal and B. D. Gupta, "Lossy mode resonance-based highly sensitive fiber optic refractive index sensor using the bilayer of FTO/HfO 2 for operation in the visible region," J. Opt. Soc. Am. B, vol. 37, no. 12, p. 3841, Dec. 2020.
[20] A. Thureau, P. Roblin, and J. Pérez, "BioSAXS on the SWING beamline at Synchrotron SOLEIL," J. Appl. Crystallogr., vol. 54, no. 6, pp. 1698–1710, Dec. 2021.
[21] P. O'Neal and N. Sapiens, "Optical calibration system for refractometers," Opt. Eng., vol. 61, no. 12, Nov. 2022.
[22] L. Zhou et al., "Coexistence of circular dichroism and asymmetric transmission in a stretchable chiral metamaterial," J. Opt. Soc. Am. B, vol. 37, no. 12, p. 3763, Dec. 2020.
[23] A. Mina et al., "Comparison of different methods used in drugs of abuse for sample validity testing including pH methods, specific gravity methods, TECOTM Drug Adulteration Test Strip and oxidant assay," Adv. Lab. Med. / Av. en Med. Lab., vol. 2, no. 4, pp. 550–557, Nov. 2021.
[24] D. R. Neal et al., "Dynamic aberrometer/topographer designed for clinical measurement and treatment of highly aberrated eyes," Opt. Eng., vol. 61, no. 12, Nov. 2022.
[25] L. Rahimi and A. A. Askari, "Ultrahigh-figure-of-merit refractive index sensor based on the Rayleigh anomaly resonance," Appl. Opt., vol. 59, no. 34, p. 10980, Dec. 2020.
[26] C. Buranakarl, S. Thammacharoen, M. Nuntapaitoon, S. Semsirmboon, and K. Katoh, "Validation of Brix refractometer to estimate immunoglobulin G concentration in goat colostrum," Vet. World, pp. 3194–3199, Dec. 2021.
[27] A. V. Dyshlyuk and O. B. Vitrik, "Resonance Effects in the Bent Waveguide-Based Fabry–Perot Resonator with Mirrors of Spatially Varying Reflectivity," Bull. Russ. Acad. Sci. Phys., vol. 86, no. S1, pp. S50–S59, Dec. 2022.
[28] K. Dhriti, A. Ahmad, and G. Kumar, "Planar Plasmonic Terahertz Waveguide Based Upon One Dimensional Array of Pyramidal Corrugations and Refractive Index Sensing," IEEE Photonics J., vol. 12, no. 6, pp. 1–10, Dec. 2020.
[29] T. Parvin et al., "Hollow core negative curvature fiber based refractive index sensor design and investigation for tuberculosis monitoring," Phys. Scr., vol. 96, no. 12, p. 125877, Dec. 2021.
[30] X. Cai, P. Pan, S. Chen, H. Wang, and H. Fu, "Refractive Index Measurement Based on Thin-Core Fiber In-Line Mach-Zehnder Interferometer and Differential Intensity Demodulation," IEEE Photonics J., vol. 14, no. 6, pp. 1–6, Dec. 2022.